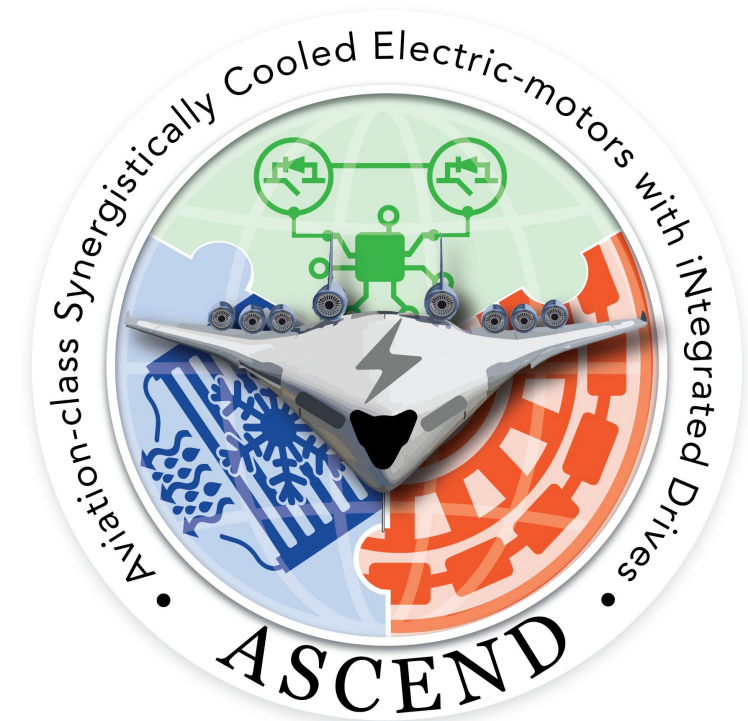
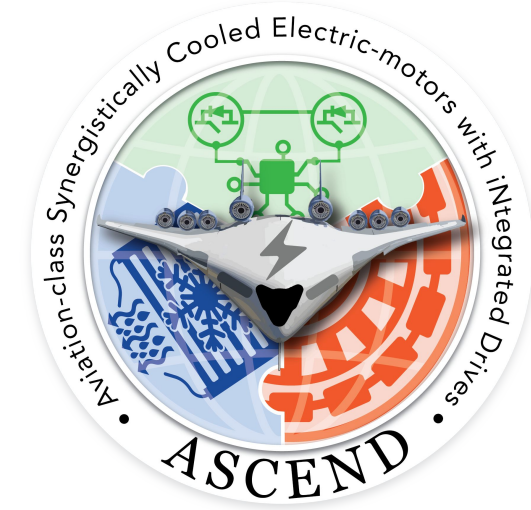


# **Aviation-class Synergistically Cooled Electric-motors with iNtegrated Drives (ASCEND)**

Annual Program Review Meeting  
June 29, 2022 – Cleveland





# AERIALIST - 2nd generation motor for lArge ElectRlc Aircraft propuLslon SysTems **Subhashree Rajagopal, Wright Electric**

## **Project Vision**

Developing tomorrow's electric aircraft



# Brief ASCEND Project Overview

Team member	Location	Role in project
Colin Tschida	Ithaca, NY	Principal Investigator
Subhashree Rajagopal	Seattle, WA	Senior Electrical Engineer
Patrick Biel	Albany, NY	Director of Power Electronics
Muhammad Shafiq	Albany, NY	CFD Engineer

## Context/history of the project

*Wright is dedicated to low emissions aviation*

*We are designing to retrofit in existing narrow-body aircraft (~100 passenger)*

*Wright is growing!*

# Solution Approach

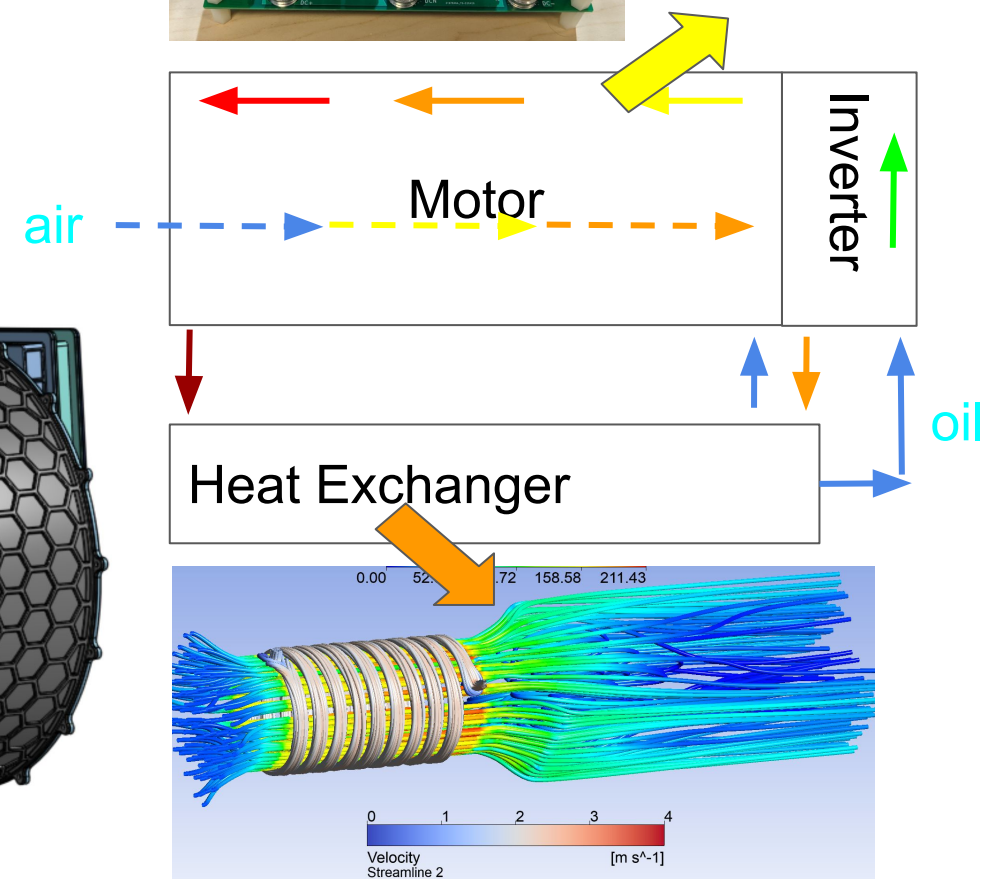
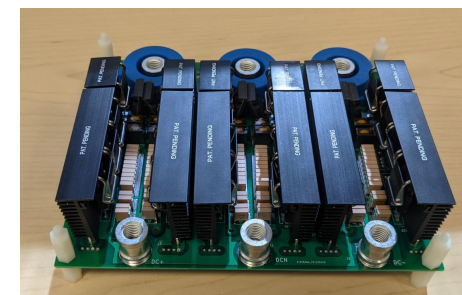
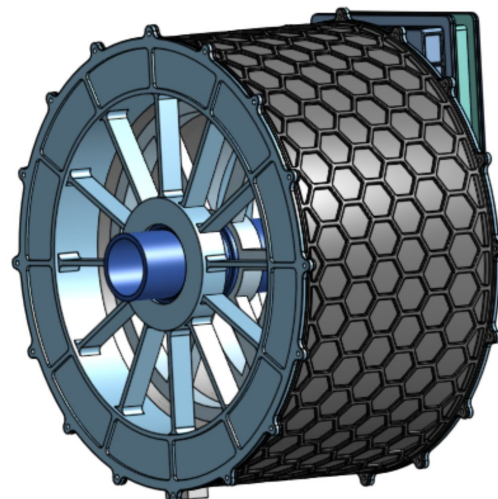
High frequency stator with Halbach rotor

High frequency, soft-switching drive

Shared thermal management

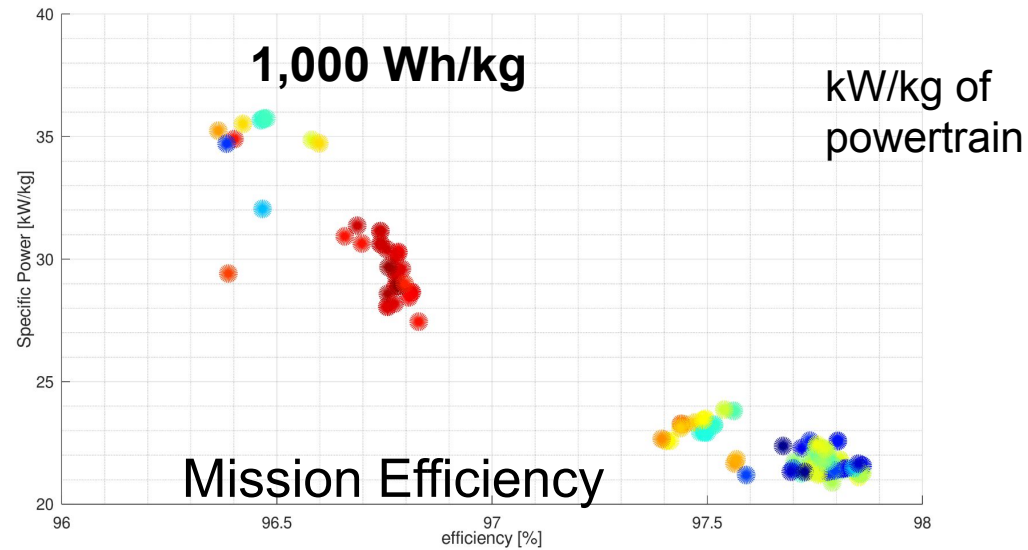
Designed to meet mission requirements

Application Metric	Status
505 kW	505 kW
12.05 kW/kg	12.1 kW/kg
5,000 rpm	5,000 rpm

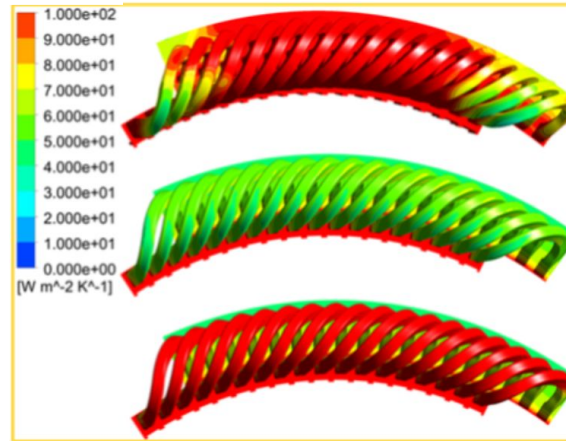
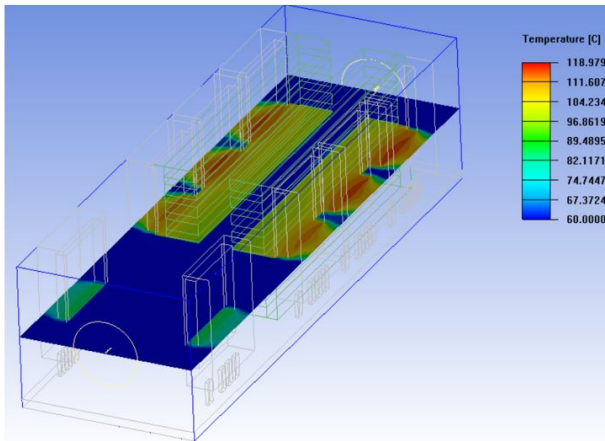
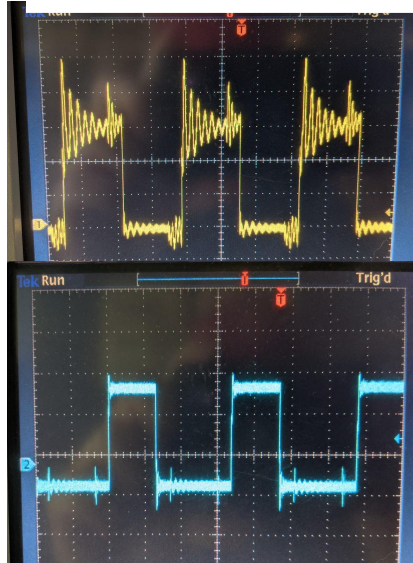




# Progress



- Design optimization for mission
- Low power testing of inverter prototype
- Selected vendors for component fabrication
- Derisk technology with related testing



# Risk Update

*Phase 1 reduces project risk*

#	Risk
1	Stator Cooling
2	Component sourcing
3	Motor Manufacturing
4	partial discharge
5	Inverter Switching
6	Thermal Management

L i k e l i h o o d	Almost Certain					
	Likely			5	2	
	Moderate			4	1	3
	Unlikely			5	6	
				4	1	
	Rare				3	2
		Insignificant	Minor	Moderate	Major	Catastrophic
Consequence						



Now



Start of project

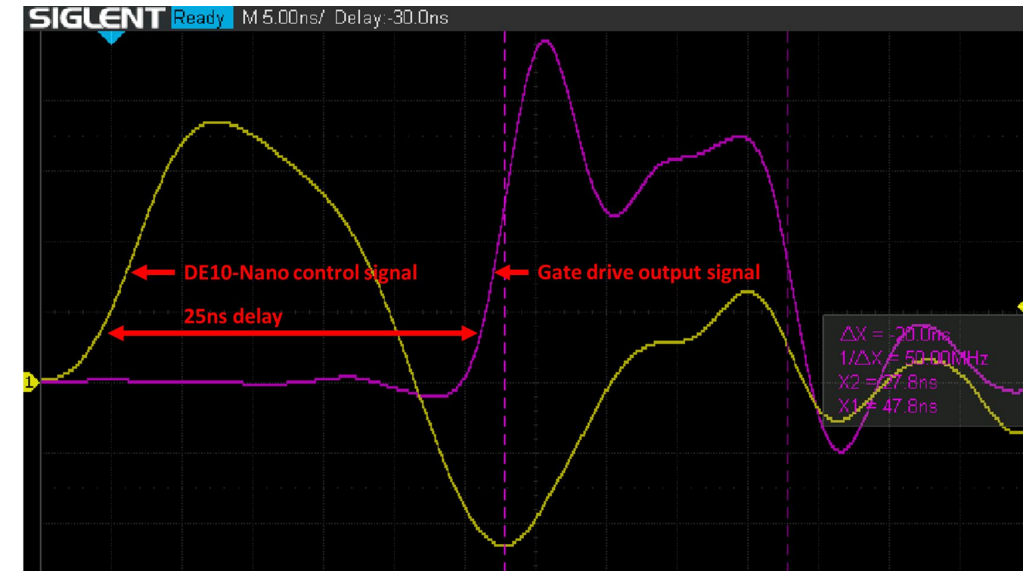
# Challenges and Learnings

## Challenges remaining

- Soft-Switching timing
- Analog Circuit design
- Validation of design assumptions of TMS

## What we have learned

- Designing for our application permits us to increase system performance



# Technology-to-Market Approach and Update

---

- ▶ **First Application:**

- Stepwise retrofit of the BAE-146
- Other applications under consideration

- ▶ **Long Term Market:**

- All-electric single aisle aircraft
- 50% of the commercial market

- ▶ **Barriers to Market Entry:**

- Gaps in regulations/standards and certification

- ▶ **Needs and Potential Partnerships:**

- Power dense energy storage







Q & A



U.S. DEPARTMENT OF  
**ENERGY**

<https://arpa-e.energy.gov>

# Motor + Power Electronics + TMS Performance

System	Requirement	Application Metric	Status
Integrated Powertrain	System Capacity	505 kW	505 kW
	Power density at takeoff for the complete powertrain (motor, drive, and TMS)	12.05 kW/kg	12.1 kW/kg
	Cost for complete powertrain	350 \$/kW	<350 \$/kW
Motor Drive	Cruise average efficiency	99.3%	99.3%
	Power density (including TMS) at takeoff	42.0 kW/kg	52 kW/kg
Electric Motor	Cruise average efficiency	94.3%	> 95%
	Takeoff rotational speed of the motor	5000 rpm	5,000 rpm
	Power density (including TMS) at takeoff	14.3 kW/kg	14.4 kW/kg